

Claims

1. A method of forming an organic electronic device, which method comprises the steps of:

- 5 a) forming a negative image of a desired pattern on a substrate or layer of the device with a lift-off ink;
- b) coating a first device layer to be patterned on top of the negative image;
- c) coating one or more further device layers to be patterned on top of the first device layer to be patterned; and
- 10 d) removing the lift-off ink and unwanted portions of the device layers above it, thereby leaving the desired pattern of device layers.

3. A method of forming an organic electronic device as claimed in claim 1 wherein the lift-off ink is insoluble in the liquid medium used to deposit the device layers to be

15 patterned.

4. A method of forming an organic electronic device as claimed in claim 1 or 2 wherein the ink comprises a liquid medium which does not dissolve the substrate or layer on which the ink is printed.

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5. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off ink is deposited on the substrate or layer by a direct printing technique selected from the following: ink-jet printing, screen printing, microcontact printing, stamping, soft lithography or electrophotographic printing using a solid or liquid

25 toner.

6. A method of forming an organic electronic device as claimed in any one preceding claim wherein the deposited lift-off ink is thicker than the device layers subsequently deposited onto it.

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7. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off pattern is from 1 μm to 50 μm .

8. A method of forming an organic electronic device as claimed in any one preceding claim wherein the ink is deposited by screen printing and the ink has a viscosity from 500 and 10,000 cP.

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9. A method of forming an organic electronic device as claimed in any one of claims 1 to 6 wherein the ink is deposited by ink-jet printing and the ink viscosity is in the range from 3 to 40 cP.

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10. A method of forming an organic electronic device as claimed in any one preceding claim wherein the ink has a surface tension in the range of 20 – 60 dynes/cm.
- 5 11. A method of forming an organic electronic device as claimed in any one preceding claim wherein the surface tension of the ink relative to the substrate is in the range 40-80deg.
- 10 12. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off ink contains from 50% to 99.8% liquid medium, by weight.
- 15 13. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off ink further comprises a colorant, a polymeric binder or one or more functional additives.
- 20 14. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off ink further comprises a cross-linking agent to permit cross-linking of the printed ink.
- 25 15. A method of forming an organic electronic device as claimed in any one preceding claim wherein partial shrinkage or micro-cracks are induced to allow a lift-off medium to penetrate the ink at the pattern edges or through its surface to aid the lift-off step (d).
- 30 16. A method of forming an organic electronic device as claimed in any one preceding claim wherein wetting of the ink is effected by a surface treatment of the substrate.
- 35 17. A method of forming an organic electronic device as claimed in any one preceding claim wherein the device layers to be patterned are each independently applied by solution-, spin-, spray-, dip-, web-, die- or evaporation coating.
18. A method of forming an organic electronic device as claimed in any one of claims 1 to 15 wherein the device layer to be patterned is applied by electroless deposition, ink-jet printing, screen printing, microcontact printing, stamping or soft lithography.
19. A method of forming an organic electronic device as claimed in any one preceding claim wherein the thickness of each device layer or multiplicity of layers is from 1nm to 1 μ m.

20. A method of forming an organic electronic device as claimed in any one preceding claim wherein the lift-off step (d) includes dissolving the lift-off ink using a lift-off liquid medium.

21. A method of forming an organic electronic device as claimed in claim 19 wherein the lift-off liquid medium dissolves little or none of the device layer to be patterned.

22. A method of forming an organic electronic device as claimed in claim 19 or 20 wherein the lift-off step (d) further includes ultrasonic agitation, stirring, spraying liquid medium and/or heating.

23. A method of forming an organic electronic device as claimed in any one preceding claim wherein the device is an OFET and the device layers are each independently selected from a conductor, a dopant, an insulator or an organic semiconductor (OSC).

24. A method of forming an organic electronic device as claimed in claim 22 wherein the device layers include a conductor that is deposited by liquid coating.

25. A method of forming an organic electronic device as claimed in claim 23 wherein the conductor is selected from the group comprising polyaniline, polypyrrole, PEDOT, doped conjugated polymer, or dispersions or pastes of graphite or particles of metal including Au, Ag, Cu, Al, Ni or their mixtures.

26. A method of forming an organic electronic device as claimed in any one of claims 22-24 wherein the device layers include an OSC, which is deposited from solution.

27. A method of forming an organic electronic device as claimed in any one of claims 22-25 wherein the device layers include an OSC comprising a polymer or oligomer including monomers of triarylamine, fluorene, or thiophene, including substituted forms thereof.

28. A method of forming an organic electronic device as claimed in any one of claims 22-26 wherein the device layers include an OSC comprising pentacene or solution coated precursor pentacene.

29. A method of forming an organic electronic device as claimed in any one of claims 22-27 wherein the device is a vertical OFET.

30. A method of forming an organic electronic device as claimed in any one preceding claim wherein the step d) forms one or more via openings.

31. A method of forming an organic electronic device as claimed in any one of claims 1 to 21 wherein the device is an OLED and at least one of the device layers to be patterned is selected from an anode, a cathode or an electroluminescent layer.

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32. A method of forming an organic electronic device as claimed in claim 30 wherein the electroluminescent layer comprises a substantially organic or organometallic electroluminescent material.

10 33. A method of forming an organic electronic device as claimed in claim 31 wherein the electroluminescent layer comprises a polymer or oligomer containing monomers of thiophene, phenylene, thiophenevinylene, phenylenevinylene, or fluorene, including substituted forms thereof.

15 34. A method of forming an organic electronic device as claimed in any one of claims 1 to 21 and 30 to 32 wherein the device is an OLED and at least one of the device layers to be patterned is selected from a hole injecting layer, hole transporting layer, electron injecting layer, electron transporting layer or interconnect.

20 35. A method of forming an organic electronic device as claimed in any one of claims 1 to 21 and 30 to 33 wherein the device is an OLED and at least one of the device layers to be patterned is a dopant or an insulator.

25 36. An organic electronic device obtainable by any one of the preceding claims.